

posterior end of the inter-ramal space, though the middle portion of the muscle had undergone retrogression. In all other Parrots the muscle was confined to the anterior fifth of this space, but in many of them evidences of its once more posterior extension could be found.

In the majority of Parrots the posterior mylohyoideus consisted of an outer stylohyoideus and an inner serpihyoideus. Various degrees in the retrogression of the outer portion could be traced, up to *Pezoporus*, in which the left-hand one had disappeared and the right nearly so, and to the Lories, in which it had quite disappeared on both sides of the tongue.

The structural characters of the tongue suggested that Parrots might be arranged in three families—Loriidæ, Nestoridæ, and Psittacidæ.

The investigation covered the study of the tongues of fifty-three species, ranging over the whole Order, the Cyclopsittacidæ excepted.

This memoir will be printed entire in the Society's 'Transactions.'

The following papers were read:—

1. On the Larynx of certain Whales (*Cogia*, *Balenoptera*, and *Ziphius*). By W. B. BENHAM, D.Sc., M.A., F.Z.S., Professor of Biology in the University of Otago, New Zealand.

[Received February 27, 1901.]

(Plates XXV.—XXVIII.¹)

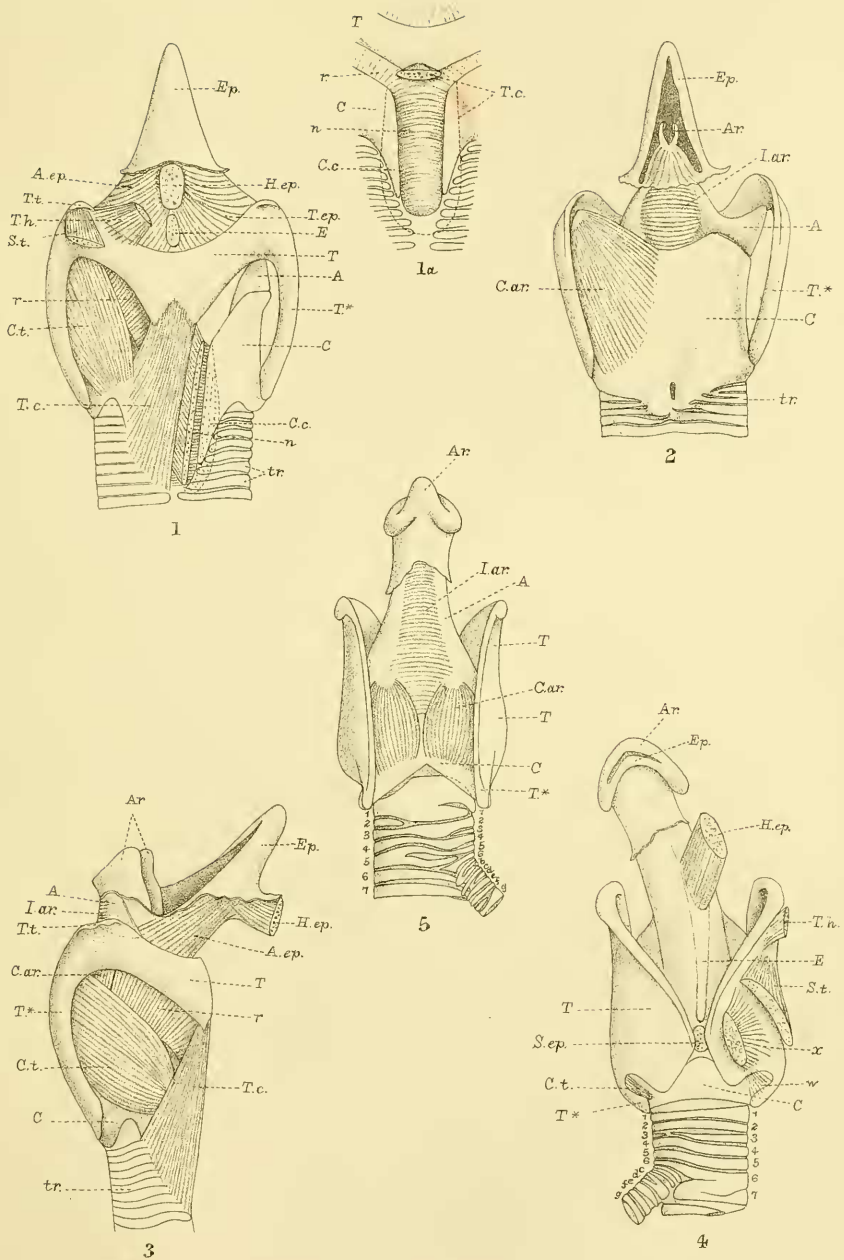
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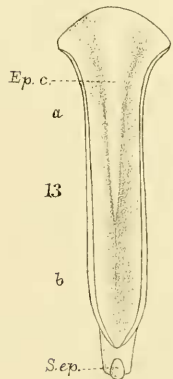
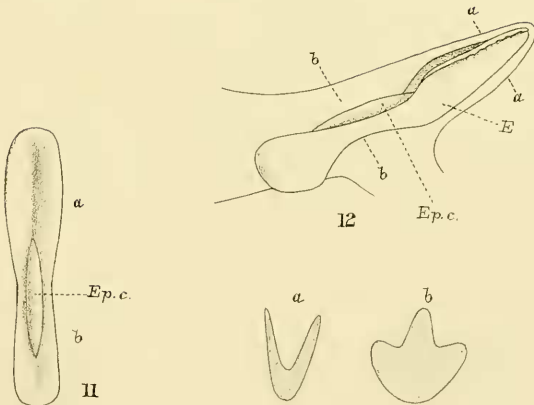
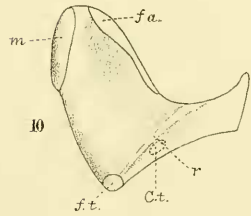
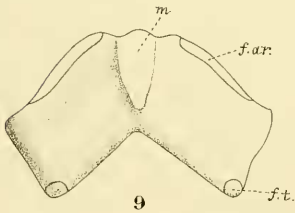
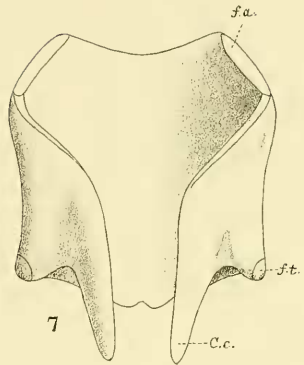
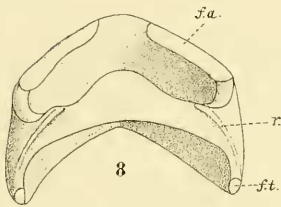
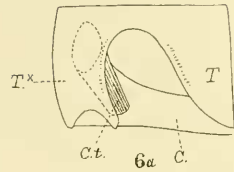
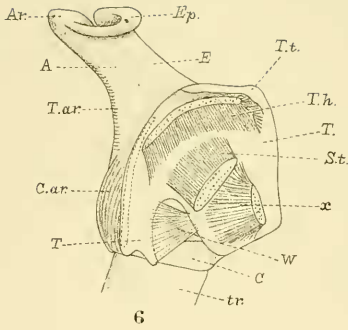
During the month of August, 1900, I had the opportunity of obtaining specimens of two species of Whales, both of which came ashore on the coast of Otago, near Dunedin, viz. a young newborn female Rorqual, *Balenoptera rostrata*, and an adult male *Cogia*, the small Cachalot (probably *C. breviceps*).

The young Rorqual was found on the beach just outside the Otago Harbour, and I received it at the Museum the day after it was thrown ashore; it was thus perfectly fresh and wholesome, and I was able to make a fairly complete dissection of it before its condition became unbearable. Since the soft anatomy of *Balenoptera* is pretty well known, thanks to the memoirs of Carte and Macalister, Delage, Turner, and others, I do not intend to give any account of it here. But on becoming possessed of some of the viscera of *Cogia*, about three weeks later, I was struck by the remarkable differences presented by the larynx in these two genera—a fact well known to students of the Cetacea.

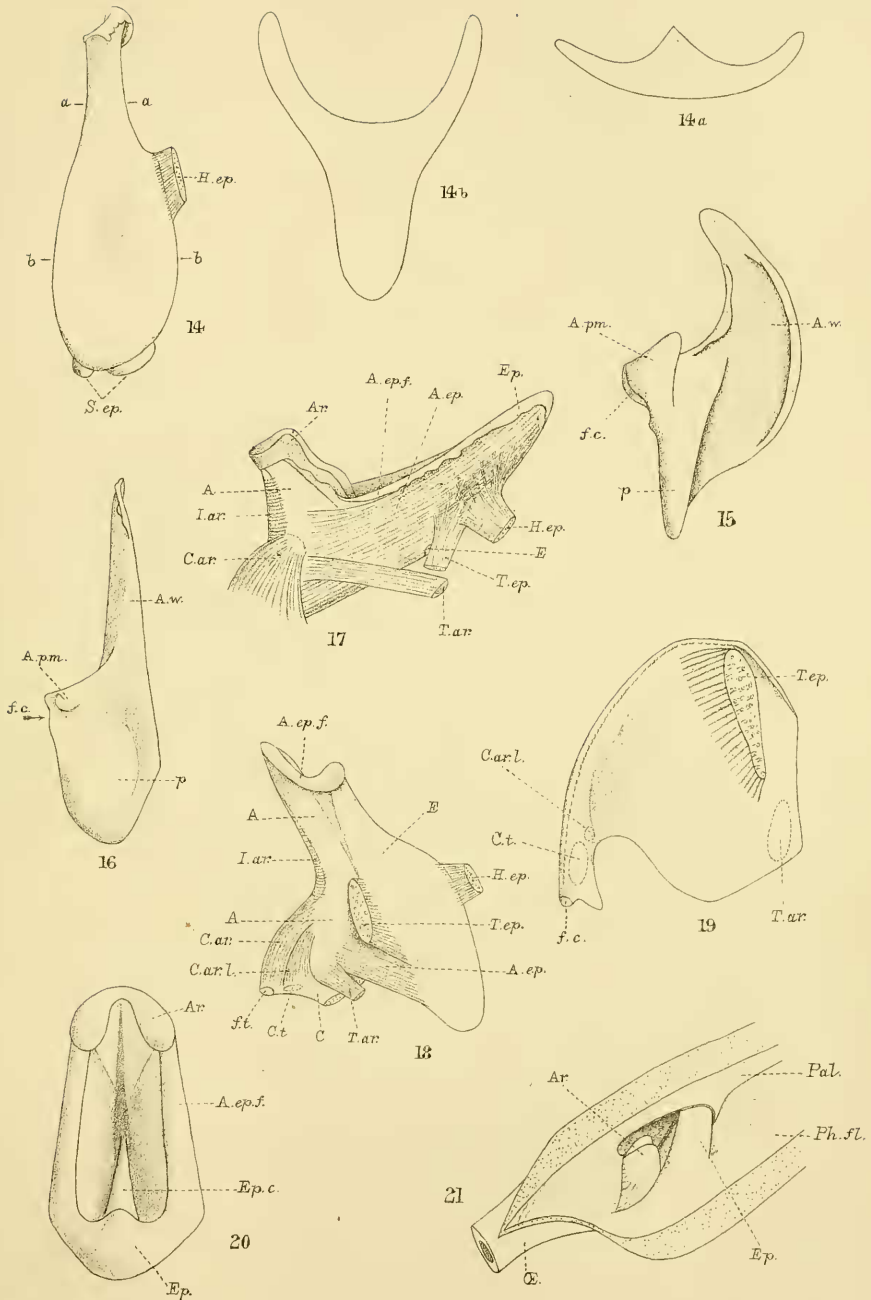
The larynx of *Cogia* is, I believe, hitherto undescribed, for

¹ For an explanation of the Plates, see p. 299.





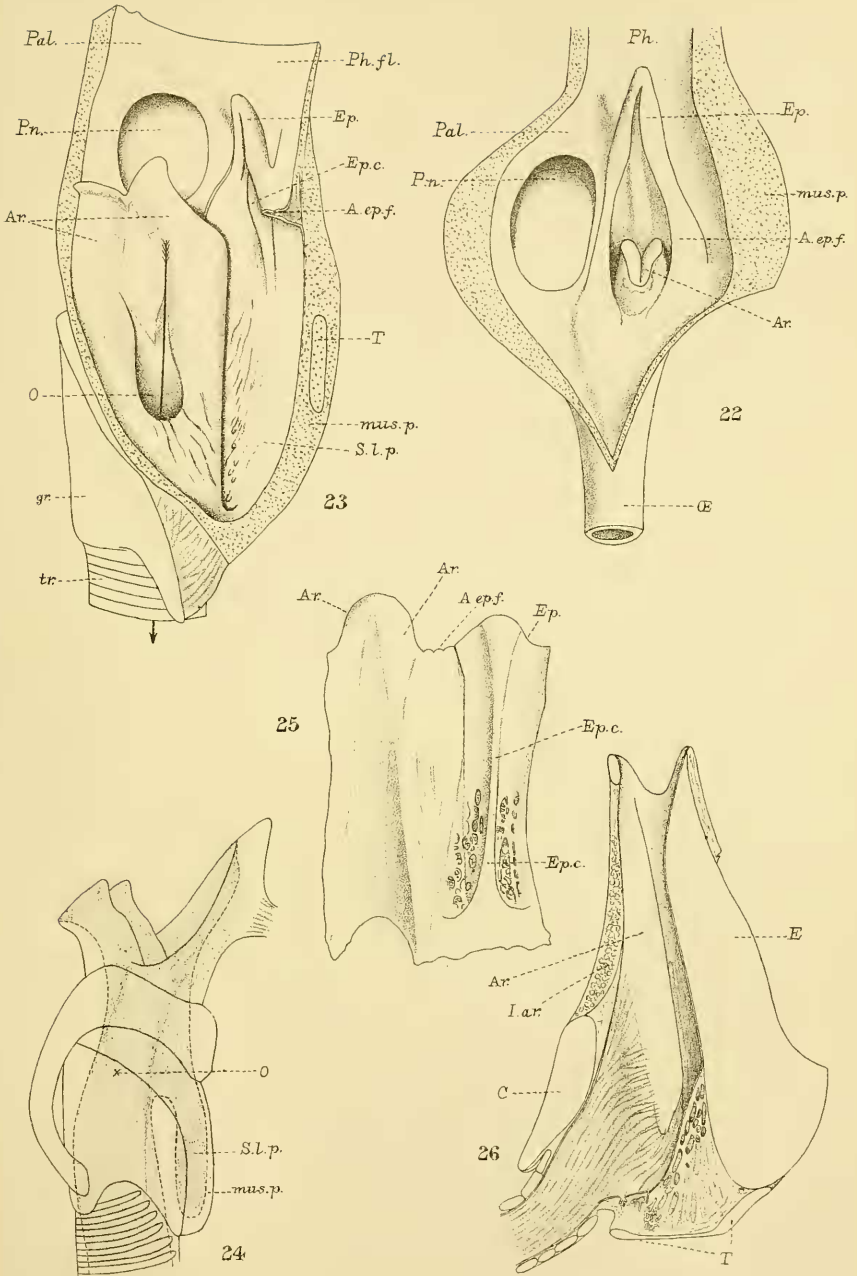




M.P. Parker lith.

Parker & West imp.

LARYNX OF BALÆNOPTERA & COGIA.



Flower and Lydekker, in their text-book of "Mammals," state that very little is known of the soft parts of this small Cachalot, and it seems, therefore, worth while to figure, side by side, corresponding views of the larynx of *Cogia* and *Balenoptera*, in order to bring out more forcibly the differences in this organ between the Odontocete and the Mystacocete: for, although the text-books of earlier authors, such as Owen, Huxley, Stannius, and others, refer to the fact, yet in such modern works as Wiedersheim no mention is made of it, and it may be that other zoologists in the same case as myself will appreciate the differences when presented pictorially.

The young Rorqual was very evidently newly born; the navel had not healed up; the umbilical cord still remained attached to the inner surface of the abdominal wall; umbilical arteries and vein still existed, and had evidently only recently been ruptured.

I had a plaster cast made of half of the body of the animal, intending to place the skeleton therein, in the way that the late Prof. Flower had had carried out in the British Museum. I found, however, that the bones were but slightly ossified and were of no use for Museum purposes.

The animal measured 9 ft. $9\frac{1}{2}$ inches in a straight line, from the tip of the snout to the bottom of the caudal notch (10 ft. 1 inch along the curve of the back). Its greatest diameter was 5 ft. $2\frac{1}{2}$ inches, at a distance of 5 ft. 7 inches from the snout.

The specimen of *Cogia* only came into my possession a week after it had been washed ashore. When I arrived at Purakanni—about an hour's railway journey from Dunedin—I found that the original finder had cut the animal about considerably. The blubber from the back, including the dorsal fin, and the "spermaceti" from the head, had been carried away, as well as the lower jaw and the caudal fluke. The head had been very skilfully disarticulated from the atlas, but had not been removed. The body had been opened, and the viscera were lying about. The body and organs were much mixed up with sand that had been blown over them. However, I ultimately obtained the entire carcass, as well as most of the internal organs.

The specimen was a fully grown, and apparently adult, male; it measured 8 ft. 9 inches in a straight line from the tip of the snout to the notch in the fluke; of this the head occupied 16 inches, *i. e.* between one-sixth and one-seventh of total length. I did not make any attempt to measure the girth.

The pectoral fin was 14 inches long in a straight line, and 15 inches along the slightly-curved anterior margin; its posterior margin presented a rounded angle 4 inches from the base and 8 inches from the tip, the distal moiety of this side being concave.

The fin was 5 inches across at the base, $5\frac{1}{2}$ inches at its widest.

The fluke, or tail-fin, was 27 inches from point to point; the median notch was $5\frac{1}{2}$ inches deep, and this point was 10 inches from the plane of origin of the fluke from the tail, so that the total length of the fin was $15\frac{1}{2}$ inches.

With regard to colour:—The dorsal surface of the body was black, the under surface of the fluke was also black; the belly dirty yellowish-white, but much discoloured; but how far the dark colour extended down the sides, and other details, I was unable to ascertain with sufficient accuracy to put on record.

The only detailed accounts of the external features of *Cogia* to which I have access are those by Owen (1865) and by Von Haast (1873).

Owen describes two specimens from Indian seas under the name of *Euphysetes simus*; the male measured 6 ft. 8 inches, and the female 6 feet only.

Von Haast's account of "*Euphysetes pottsii*" (according to Flower, these names are synonyms of *Cogia breviceps*) deals with a specimen thrown up on the New Zealand coast which measured 7 ft. 2 inches, its tail $16\frac{1}{2}$ inches, the pectoral fin 9 inches by $3\frac{3}{4}$ inches.

"The colour black, belly greyish white."

These specimens, then, are considerably smaller than my *Cogia*.

I hope to give, in a later contribution, some account of its viscera, but at present will confine my remarks to the larynx.

I. THE LARYNX OF *BALÆNOPTERA ROSTRATA*.

The only detailed account of this organ in the Rorqual that I have been able to consult is that by Drs. Carte and Macalister (1867), who in their very careful and interesting memoir on the anatomy of the Rorqual give a fairly good description of the external features, and of the muscles, both extrinsic and intrinsic; but the figures illustrating this account are small and poor, and no sufficient details are given as to the shape of the cartilages. In some respects I have to differ from these authors.

I have not been able to consult the original memoir of Dubois (1886), and only know the general conclusions to which he arrives from the abstract in the *Zool. Jahresbericht*, and this publication makes no reference to any account of the larynx in the abstracts of Delage's memoir (1885). It is likely, therefore, that I am repeating, to some degree, work that has already been carried out; but my apology lies in the isolation in which scientific men have to work in New Zealand.

It will be seen that in general, the larynx of *Balænoptera* agrees with that of *Balæna*, but in several details it differs therefrom.

The *aditus laryngis* is, in form, an isosceles triangle, with the apex directed anteriorly upwards; the sides are formed by the aryteno-epiglottid folds (*A.ep.f.*), which diverge posteriorly and embrace the arytenoid bodies, while they converge anteriorly and meet at the apex of the epiglottis. (Plate XXVIII. fig. 22.)

The epiglottis is a tongue-shaped or conical body arising from the floor of the pharynx and directed upwards and forwards. The tip of the epiglottis is, as the drawings show, a rounded point, and

contrasts very strongly with that of the Odontocete. There is no special means for "locking" it into the narial canal, though its free end is inserted into the posterior nares, in the manner so well known for Cetacea and several other Mammals.

The epiglottis is 3 inches long in this young Rorqual: its postero-dorsal surface is grooved, the sides of the groove being thick and rounded near the apex, but becoming thinner as they pass into the aryteno-epiglottid folds. The groove is, near the end, narrow and almost slit-like, the lips being closely pressed together in a state of rest. Along the floor of this groove is a ridge, which commences about one inch from the tip of the epiglottis, and increasing in height as it passes backwards, is continued into the sublaryngeal pouch (see below) for a short distance and then gradually dies out.

The arytenoid bodies project upwards from the floor of the pharynx to a height of only $1\frac{1}{2}$ inches; they are sufficiently high just to enter the posterior nostril, though when food is passing along it appears as if, with the distension of the pharynx, the arytenoid bodies would not reach the nostril. (Plate XXVII. fig. 21.) But as Carte and Macalister show, the extensive muscles are so arranged as to pull the whole larynx upwards during the process of respiration. The two bodies are united posteriorly, and this point is somewhat recurved, but their anterior dorsal margins are free and enclose a deep groove—a groove that, becoming deeper, leads downwards into the laryngeal chamber, which is entered through a large oval aperture, the sides of which are supported by the posterior processes of the arytenoid cartilages. (Plate XXVIII. fig. 23.)

The epiglottidean furrow, on the other hand, leads downwards into the "sub-laryngeal pouch." This is a long tubular sac, ending blindly behind, provided with thick muscular walls, and lined with a smooth mucous membrane, which laterally is somewhat folded and trabeculate. This pouch lies on the ventral aspect of the larynx between the two cornua of the cricoid cartilage. (Plate XXV. fig. 1 a.)

The ventral wall of the pouch is formed by muscle, its dorsal wall by the arytenoids, between which the pouch communicates, by a wide aperture, with the laryngeal chamber.

The sub-laryngeal pouch is essentially a caecal diverticulum of the ventral wall of the larynx, between the thyroid and cricoid cartilages. (Plate XXVIII. fig. 24.) It exists in *Balaena*, though the musculature there seems to be somewhat differently arranged according to the account given by Eschricht and Reinhardt. Whether it is homologous with the sacs present in several other mammals seems extremely doubtful. (See below.)

Carte and Macalister (p. 233) describe a "hood-like fold" of the mucous membrane of the floor of the pharynx just in front of the root of the epiglottis. This I have not seen. My figures (21-24) were drawn from the fresh animal, before I had looked up any literature on the subject; but I do not think I should have

omitted to notice a fold—sufficiently large, according to these authors, to be drawn over the aditus laryngis—if it had existed.

The drawings given by these authors are small and indistinct, and from an inspection of them I was inclined to regard this “fold” as the epiglottis itself; but their account in the text is quite precise, and from the size of the “fold” in the adult it is remarkable that it does not exist in the young.

The *general form* of the larynx is shown in figs. 1, 2, 3, as seen in various aspects. It is of greater diameter from side to side than in the dorso-ventral direction, and the aryteno-epiglottid apparatus is relatively short, as compared with the long tube in the Odontocete.

The base of the larynx passes gradually into the trachea, the rings of which are incomplete on the ventral surface.

The windpipe is, of course, very short, and there is no “third bronchus” (nor is there in *Balena*), such as will be seen in *Cogia*.

It will be convenient to describe the cartilages first, and then refer to the muscles connected with them.

The Cartilages.

In dealing with the topographical relations, the larynx is supposed to be still within the body of the animal, which is in its natural position, back upwards.

The *thyroid cartilage* consists of a distinct body and paired posterior cornua. The body is a transverse, narrow band, *i. e.*, it has a very short antero-posterior diameter; its anterior margin is concave, its posterior convex, but with a median V-shaped notch. At the extreme right and left extremities, where the body becomes continuous with the cornua, the anterior margin is thicker and more prominent than elsewhere; the ridge-like tubercle so formed probably represents an anterior cornu; just below it is inserted the sterno-thyroid muscle.

Opposite this ridge-like tubercle, the body of the thyroid curves abruptly backwards, and forms the conspicuous long posterior cornu on each side. This is a stout rod, curved as it passes backwards (*i. e.* posteriorly) with a rather strong convexity towards the dorsal surface; it is, of course, articulated at its hinder end with the cricoid cartilage.

Whereas the body of the thyroid is flat and band-like, the cornu, though of the same character at its origin, soon becomes a thick subcylindrical rod.

It is 4 inches long, measured from the anterior margin of the body to the posterior end of the cornu.

The body of the thyroid measures 5 inches from side to side; measured from the outer extremities its antero-posterior width (*i. e.* length) is about one inch, though this becomes greater towards the middle; the depth of the notch is $\frac{1}{2}$ inch; a line from the bottom of the notch to the anterior margin, on the median line, measures $\frac{7}{8}$ inch.

The *cricoid cartilage* differs from the form usual in mammals in that it is incomplete ventrally; it consists of a great dorsal plate, which curves round the sides and is produced backwards, towards the ventral face, into two "horns" or processes. (Plate XXVI. fig. 7.)

We may, therefore, distinguish a body and a pair of cornua. The body is nearly square; when seen from the dorsal surface, its anterior margin is nearly straight in the middle line, though the corners are obliquely truncated to bear the arytenoid cartilage; the posterior margin is produced backwards in the middle line, to form a somewhat rounded prominence, with which, in this young individual, 4 or 5 of the upper tracheal rings are continuous.

The dorsal surface is almost flat, slightly concave in the middle. As this broad plate of the cricoid curves round the side of the larynx its longitudinal diameter diminishes.

The anterior margin, beginning at the arytenoid facet, commences to slope gently backwards, and the inclination increases as the ventral surface is reached, till it makes an abrupt backwardly-directed curve near the middle line, giving rise to a rounded angle; the margin then continues nearly straight backwards to constitute the ventral or inner edge of the cornu of the cricoid.

The posterior margin, meanwhile, is inclined forwards from the mid-dorsal line towards the thyroid facet, but the inclination is slight; beyond this point it is continued forwards for a short distance and then curves backwards, forming a shallow lateral bag in the cricoid; their margin then passes nearly directly backwards to form the dorsal or outer edge of the cornu.

The cornu itself is not so definitely marked off from the cricoid as is the cornu of the thyroid from its body, it is rather the ventral posterior angle drawn out backwards to form on each side a short parallel bar for the support of the peculiar "sublaryngeal pouch" of the *Mystacocete*.

As to measurements, the cricoid is 3 inches long in the mid-dorsal line and 3 inches across, taken from the lower edges of the arytenoid facets, and the same between the thyroid facets, while the space between the two arytenoid facets is $1\frac{1}{2}$ inches. The lateral margin, as seen from the back, *i. e.* the distance from the outer edge of the arytenoid facet to beyond the thyroid facet, is 2 inches.

The ventral margin of the cricoid (or rather of its cornu) is 2 inches; the dorsal or outer edge of the cornu is $1\frac{1}{2}$ inches.

In the text-books, both of Owen and Huxley, the ventral incompleteness of the cricoid is mentioned.

Carte and Macalister give no clear figure of the cricoid, and do not represent the ventro-posterior cornua; but in the text this "tongue-shaped process" is described as reaching to the first ring of the trachea. In the present youthful specimen it extends backwards to the sixth ring.

The *arytenoid cartilage* consists of a somewhat conical "body" or *processus muscularis*, of a stout cylindro-conical posterior

“process,” and of a thin lamelliform, antero-ventrally placed “wing.” (Pl. XXVII. fig. 15.)

Of these, the body and the “wing” are visible from without, after removal of the muscles, while the posterior “process” can only be seen by removal of the wall of the larynx.

The “body,” or processus muscularis, of the arytenoid is somewhat conical, with an obtusely rounded apex directed forwards and outwards (Pl. XXV. fig. 2); the base—measuring $1\frac{1}{4}$ inches—is narrow and elongated transversely; it articulates with the cricoid in a typical fashion at the antero-lateral dorsal margin of the latter; its apex serves for the insertion of the crico-arytenoid muscles.

The anterior “wing-like” process (=supra-arytenoid of Thompson) rises from the body by a comparatively thick basal region, but this soon becomes a thin plate, which is somewhat crescentic in form—the form is, after all, best appreciated by a study of the figures. One horn of the crescent is directed forwards and dorsally, and the right and left “wings” approach one another at their extremities, supporting the “arytenoid bodies.”

The posterior half of the crescent is continuous with the posterior process of the arytenoid: the convex margin of the “wing” is directed inwards, towards the cavity of the larynx; its extreme edge is reflected outwards, and the whole of the lower half of the wing is set at an angle with the plane of the posterior process, so that a “fossa” is enclosed by them.

In this fossa, to the external concave face of the arytenoid wing, are inserted the upper portions of the aryteno-epiglottidean muscles.

The third part of the arytenoid, the posterior “processus vocalis,” arises from the body by a broad stout base; its long axis is directed backwards, parallel to its fellow, close to the dorsal wall of the larynx. In addition to serving for the insertion of the lower aryteno-epiglottidean muscles and the thyro-arytenoids, these two processes form the margins of the true entrance into the laryngeal sac.

The total length of the arytenoid is 4 inches, measured in a straight line from the anterior end of the “wing” to the posterior tip of the “process.”

In the Greenland Right Whale the two processus vocales of the arytenoid cartilages are continuous at their distal ends, forming a posterior support for the laryngeal opening; this is not the case in the young Rorqual, though the ends were connected by dense connective tissue, and very probably this became replaced by cartilage in older animals.

The *epiglottid* cartilage is embedded in the aryteno-epiglottid and other muscles, so that only a small piece of it comes to the surface. On dissection, however, the cartilage is found to have the usual form (Pl. XXVI. figs. 11, 12), resembling a shoe-horn; it consists of an upper thin plate (*a*) with a wide shallow groove, and a lower thicker moiety (*b*) which is connected by fibrous tissue

to the thyroid cartilage, and whose lower end is seen projecting through the muscles (Pl. XXV. fig. 1); the upper end is in this young Rorqual very thin, and the margin is reflected to support the overlying mucous membrane; the ridge supporting the "cushion" is of short extent and does not reach the upper end.

It measures $3\frac{1}{2}$ inches in length; $\frac{3}{4}$ inch deep at its base, which is $\frac{1}{2}$ inch wide, while the upper region is $\frac{3}{8}$ inch wide.

Before passing to a consideration of the muscles connected with the cartilages, reference may be made to the form of the laryngeal cartilages in *Balena mysticetus*, which are fully and beautifully figured by Eschricht and Reinhardt (1866).

The form of the cartilages is very similar in the Right Whale to those of the Rorqual, though, as would be expected, the proportions of the various cartilages are slightly, but not markedly, different; the only important divergences are that the posterior processes of the right and left arytenoids are united behind the entrance to the larynx, and the smaller size of the epiglottid cartilage, while the body of the thyroid is of very much greater extent than in the Rorqual; nevertheless these two members of the *Mystacocetes* have a larynx formed on one plan, and this plan is very different from that of the *Odontocetes*.

The Musculature of the Larynx.

Drs. Carte and Macalister gave a detailed account of the various muscles of the larynx—both extrinsic and intrinsic—for *Balenoptera*, and I have made no attempt here to go over this ground. I shall content myself with referring to those only that are conspicuous in this whale, and those that are of interest in contrast with the larynx of *Cogia*. Carte and Macalister recognize 17 muscles, intrinsic muscles, in the larynx; most of these I have identified.

1. The *crico-thyroid* muscle (Pl. XXV. fig. 1, *C.t.*) is of considerable size; it arises from the hinder half of the latero-ventral face of the cricoid (body); the muscle-fibres pass forwards and outwards, diverging as they go, to be inserted on the inner surface of the posterior cornu of the thyroid.

2. The ventral surface of the larynx is occupied by a great bundle of muscle, longitudinally disposed in the middle line; on dissection it is found that this mass of muscle forms part of the wall of the sublaryngeal pouch, and can readily be separated into an external layer of longitudinal muscles and an inner sheet of circular fibres. Carte and Macalister describe and figure only the latter, and state that "the thick walls are almost entirely composed of circular fibres."

(a) The longitudinal muscles of this sublaryngeal sac take their origin in the body of the thyroid, to which they are attached in the sides of the V-shaped notch (Pl. XXV. fig. 1, *T.c.*) and on the inner face in the mid-line. From their point of origin the fibres spread out on both sides, forming two more or less distinctly

separable sheets, a right and a left; these are inserted partly in the "cornu" of the cricoid, and partly in the five or six uppermost tracheal rings on each side.

This longitudinal muscle is, topographically, a "*thyro-cricoid*."

(b) Below the "*thyro-cricoid*" is a thick layer of muscle ($\frac{3}{4}$ inch in thickness), dispersed transversely for the most part, but some fibres pass entirely round the sublaryngeal sac (Pl. XXV. fig. 1a, n). The transverse muscles are inserted at each end to the inner (*i. e.* dorsal) face of the cricoid cornu.

(c) This transverse, or inter-cricoid, muscle is not distinctly separated from a series of muscle-fibres (*r*) that also are related to the sublaryngeal sac. These fibres pass from the antero-ventral margin of the cricoid, obliquely forwards to their origin in the inner face of the body of the thyroid. The more ventral fibres of this muscle, becoming more and more oblique with regard to the sagittal plane, ultimately become transverse, and I was unable to separate this sheet from the "transverse muscles" just described, but they are quite distinct from the longitudinal thyro-cricoids.

This sheet of "accessory crico-thyroids" (*r*) forms the side-walls of the anterior part of the sublaryngeal pouch.

Murie (1871) has suggested that the muscular wall of this pouch is derived from the thyro-arytenoid muscle; in this he is supported by Dubois (1886), who sees also a representative of the lateral crico-arytenoid in part of the musculature. In this latter view I am inclined to concur, so far as my observations on *Balenoptera* go; for the sheet of muscle labelled "*r*" in the figures appeared to be quite continuous with that portion of the crico-arytenoid which passes round to the side of the cricoid, and it was only separable by careful dissection. Now this muscle (*r*) is continuous with "*n*," which forms the inner muscular coat of the sublaryngeal pouch, so that the representative of the "lateral crico-arytenoid" is here in the *Mystacocetes* of enormous size.

In discussing the myology of the human larynx, Kanthack (1892) has, by the use of microscopic sections, confirmed the view held by Disse and Fürbringer that the "lateral crico-arytenoid" is only part of—"a second head of"—the thyro-arytenoid, some of the descending fibres of which "blend with the lateral crico-arytenoid, and come into close connection with the crico-thyroid." I think my observations confirm this view.

3. The *thyro-epiglottidean* muscle (*T.ep.*) is also a conspicuous constituent in the ventral region of the larynx; it arises from the inner face of the lateral region of the body of the thyroid, and passes forwards into the mass of muscle that forms, with the cartilage, the "epiglottis." The fibres of this muscle are not distinctly marked off from that part of the aryteno-epiglottid muscle lying in front of the thyroid.

4. From the dorsal surface (Pl. XXV. fig. 2) two muscles are seen: the paired *crico-arytenoids* (*C.ar.*) and the *inter-arytenoid* (*I.ar.*).

The circo-arytenoid is a powerful muscle arising from the greater part of the dorsal and lateral face of the cricoid, the lateral portion being concealed below the crico-thyroid. The muscle passes forwards to be inserted in the apex of the processus muscularis of the arytenoid cartilage.

The lateral portion is not separable from the posterior portion (as Carte and Macalister and others have pointed out); there is no distinct lateral crico-arytenoid, it is one huge mass of muscle.

5. The *inter-arytenoid* muscle has the usual disposition, and, as already remarked, arises from the "wing" of the arytenoids.

6. The *thyro-arytenoid* muscle (Pl. XXVII. fig. 17, *T.ar.*) arises from the inner face of the body of the thyroid near the middle line—precisely as in the human subject—and is inserted into the ventral or inner surface of the body of the arytenoid, and partially to the upper part of the posterior process of the latter cartilage, above and external to the *aryteno-epiglottid* muscle.

7. The latter muscle (*A.ep.*)—which is much less streaked by blood-vessels—passes from the outer face of the wing of the arytenoid, and also from the posterior process of the same, to the epiglottid cartilage, which is embedded in muscle, and here the substance of the muscle is penetrated by fibres of the *hyo-epiglottid* and *thyro-epiglottid*.

This *aryteno-epiglottid* in reality consists of a supero-internal sheet attached to the arytenoid wing, and an infero-external sheet attached to the arytenoid process. These sheets are not well defined on their outer surface; but when the mucous membrane of the larynx is dissected away their demarcation is readily seen.

8. The *hyo-epiglottid* muscle (*H.ep.*), when it reaches the epiglottis, appears as a single muscle inserted in the antero-ventral face of the epiglottid cartilage; the fibres mingle with those of the previous muscles, some passing forwards, and some curve upwards round the side of the epiglottis.

As to the extrinsic muscles of the larynx, I will only refer to two, the *thyro-hyoid* and the *sterno-thyroid* (Pl. XXV. fig. 1, *T.h., S.t.*).

The *thyro-hyoid* arises from the anterior region of the ventral surface of the thyroid cartilage, along nearly its whole width; it is triangular in outline, as the fibres converge forwards to be attached to the hyoid cartilage, near the middle line. This muscle is represented and described by Carte and Macalister, but the existence of the *sterno-thyroid* in *Balænoptera* is explicitly denied by them, though it appears to have been recognized by later authors. Certainly there is a muscle of considerable size attached to the ventral face of the thyroid near the lateral margin where the "cornu" arises, where fibres pass backwards as a broad sheet an inch and more across, which is directed downwards and backwards towards the sternum. Unfortunately I had cut through this muscle without noting carefully its relations, while tracing out the blood-vessels; but it is, I think, pretty evident, from the direction of its fibres, that it goes to the sternum.

II. THE LARYNX OF *COGIA*.

From the few references to this small Cachalot that I have been able to discover, I gather that very little is known of its viscera. The larynx agrees on the whole with that of other Odontocetes hitherto described in detail, but in certain points—as, for instance, and in particular, in the duplicity of the thyroid cartilage—it appears to be unique amongst the Cetaceans, at least so far as is indicated in the small amount of literature available and references therein.

The specimen to which this larynx belonged had, as I have stated above, been cut open and injured in various ways before I was able to obtain possession of the carcase, and the larynx itself had been cut through and severed from the pharynx and from the hyoid bone, hence I am unable to give an account of the relations of the organ to the neighbouring parts; but, as these are well known for several other genera, this deficiency is of little importance.

The *general form* of the larynx is seen in the accompanying drawings (Pl. XXV. figs. 4, 5, Pl. XXVI. fig. 6). It has a greater diameter dorso-ventrally than laterally, which is the reverse of the condition in *Balaenoptera* and in *Globiocephalus melas*, according to Murie (1867). Its dorso-ventral diameter (3 inches) is much greater than that of the trachea ($1\frac{3}{4}$ inches), so that the postero-ventral margin projects considerably and forms a veritable “pomum adami.”

From the upper and anterior end of the larynx the conjoined arytenoids and epiglottid cartilages project as a distinct tube, and this characteristic Odontocete tube is directed upwards and forwards towards the dorsal surface; this makes a very distinct angle with the longitudinal axis of the laryngeal cavity, whereas in the Rorqual the arytenoids and the epiglottis diverge from one another, each forming an angle with the axis of the larynx, but in opposite directions.

The “aryteno-epiglottidean tube” projects upwards from the floor of the pharynx for about $1\frac{1}{2}$ inches. The upper end is thickened so as to be firmly clasped by the velum palati and retained within the narial canal; it had been cut away from its natural position, so that the relation of the end of the tube to the nares could not be ascertained, though there is no reason to believe it to be different from what has been described for other Odontocetes. The aditus laryngis (Pl. XXVII. fig. 20), when stretched to its fullest extent, is somewhat rectangular, with thickened, rounded margins; the lateral margin on each side is formed by the thick and fleshy “aryteno-epiglottid” fold, which reaches upwards to the apex of each of the cartilages concerned; the dorsal margin by the rounded edges of the two arytenoid bodies, which are continuous along their dorsal surfaces right to their tips, and are in strong contrast with those of *Balaenoptera*, for in place of their lamelliform separable plates, we have in the Odontocete a thick, rounded or continuous fold. The ventral margin of the aperture

is, of course, formed by the tip of the epiglottis, also thick and rounded.

This aperture is, then, perfectly well defined; it measures two inches by one inch, but it is rather wider at the ventral than at the dorsal (arytenoid) end. As seen from the side, this tube is somewhat peniform, the free end terminating in the thick lips just referred to, the arytenoids projecting beyond the epiglottis.

I have seen no trace or indication of a sublaryngeal pouch in *Cogia*, such as has been described by Murie (1871) for Risso's Grampus, by Watson and Young (1879) for *Beluga*, and by Sir Wm. Turner (1886) for *Mesoplodon*.

Murie writes (p. 127), near the base of the epiglottis there is "a median orifice leading into a moderate-sized pouch, which fills in great part the angle of junction between the enlarged epiglottis and the thyroid cartilage;" and Turner says (p. 165) that between the forks of the bifurcated epiglottis and the upper border of the thyroid cartilage there is a shallow mesial pouch, lined by mucous membrane, which freely communicates with the interior of the larynx.

With these statements before me I looked carefully for this pouch in *Cogia*, but it is absent. There is no space or "angle" between the epiglottis and the thyroid such as Murie describes, and there seems to be actually "no room" for any such pouch. At any rate, there is none, nor is there any glandular tissue to represent it, which Murie describes and figures (p. 128) in relation to the pouch.

In *Cogia* the lining membrane both of the arytenoids and of the epiglottis is smooth; the median ridge on the latter forms a slight depression on each side (which is precisely what occurs, too, in *Balaenoptera*), and in the lower half of these lateral grooves the mucous membrane is pitted; these small pits and depressions are, however, present only on the sides, not in the middle line as Murie describes for Risso's Grampus. Nor does he mention any pouch in *Gl. melas* (1867), nor do I find one in *Ziphius* (see below).

The Cartilages.

The tracheal rings are here complete, and the upper ones present certain irregularities that will be better understood by reference to the figures than by a description.

About one inch below the larynx the trachea gives off on the right side a bronchus—the third bronchus—as in most other Odontocetes.

The *cartilages*, as will be seen by a glance at the figures, differ very considerably in form and proportions from the corresponding parts in the Rorqual.

The *thyroid cartilage* (Pl. XXV. fig. 4, *T.*) is represented by *two separate pieces*, a right and a left, which meet ventrally. These two halves may be termed for convenience the thyroid plates or *alæ*. Each thyroid plate presents a "body" and cornu, and forms

one side of the larynx, meeting its fellow at a distinct angle, and so forming a ridge.

The body is irregularly rectangular (Pl. XXVI. fig. 6), with a nearly straight but slightly curved ventral border having a thin edge, a curved anterior border presenting a recurved and thickened edge, which passes dorsally with the posterior cornu; the posterior border of each ala is oblique but straight, while the dorsal border is curved, and passes forwards to join the root of the posterior cornu.

These various "borders" pass into one another at rounded angles, but the angle formed by the ventral and posterior borders is better marked than the rest, and it is at this angle that the two alæ—the right and left—approximate most closely; nevertheless they only just meet, and this when the apparatus is at rest. It is here that the lower end of the epiglottis rests, as will be seen later.

The posterior cornu of the thyroid is a short, flat, narrow plate, whose base passes quite imperceptibly into the dorso-anterior region of the body, but between the cornu and the dorsal border of the plate there is a well-marked "bay."

Each thyroid plate is nearly flat; it is only feebly convex in a dorso-ventral direction (a convexity which is slightly exaggerated in the figure of the ventral view); the edge is thin, except along the anterior border, which is thick and everted, and probably represents the "anterior cornu."

The measurements of this plate are as follows:—

The ventral border is 3 inches, measured along the curve.

The posterior border is $2\frac{1}{4}$ inches.

The anterior border is $1\frac{1}{4}$ inches.

The dorsal (behind the cornu) is 2 inches.

The outer curve of the posterior cornu is $4\frac{1}{4}$ inches, while its inner (*i. e.* ventral) margin is about $1\frac{1}{2}$ inches, and its breadth $\frac{3}{4}$ inch.

In the Pilot Whale the figures and account given by Murie show a very different thyroid; the body, which is single, being transversely extended across the ventral surface of the larynx, while the posterior cornua are much longer, leaving a deep wide bay on each side between themselves and the body.

The *cricoid cartilage* (Pl. XXVI. figs. 8, 9, 10) is a complete ring, and, as usual, is of greater height (*i. e.* antero-posterior length) on its dorsal half than on its ventral.

The dorsal half of the ring is a broad thick band, deeply excavated on its hinder margin, while its anterior margin is irregularly convex; when viewed from this aspect, then, it has the appearance of an inverted V with a very open angle (about 90°) and thick limbs.

The median line of this dorsal face projects as a slight convex ridge, separating the right and left muscular fossæ from one another. The sloping sides bear on the upper margin the

arytenoid cartilages, and below the articular facets the cricoid passes as a nearly horizontal band, much narrower than before, round the side and across the ventral surface to the other side. At the lower angle formed by the lateral and dorsal moieties is the facet for the thyroid cornu, and from here a slight ridge passes obliquely forwards and ventralwards to reach the anterior margin of the latero-ventral moiety of the cricoid; this is much thinner and of less diameter than the dorsal moiety.

The measurements of the cricoid are as follows:—

Length along the median dorsal ridge $1\frac{1}{4}$ inches.

Width of each limb of V $1\frac{1}{2}$ inches.

Separation of thyroid facets 2 inches.

Width of the latero-ventral moiety $\frac{1}{2}$ inch

(except in ventral mid-line, where it is $\frac{3}{4}$ inch).

In the Pilot Whale the cricoid has a much greater posterior (dorsal) surface, for according to Murie (1871) it is a "trifle longer than the body of the thyroid," while on the ventral surface it is produced into completely posterior cornua which embrace the trachea and "wellnigh meet in the mid-line."

In the Porpoise, too, the cartilage is incomplete ventrally (Owen).

The *arytenoid cartilage* (Pl. XXVII. fig. 16) is of considerable length, as in other Odontocetes, and though the same regions may be recognized as in the arytenoid of *Balenoptera*, these are less distinctly marked off from one another. But the descriptive terms used in that Whale are no longer appropriate here. In general form it closely resembles the corresponding cartilage in the Porpoise.

Each arytenoid is a long flat rod, oval in transverse section through the greater part of its extent, broader and thicker inferiorly, thin and flat superiorly. On the dorsal side is a distinct shoulder, at a point about two-thirds of its length from the summit; this makes nearly a right angle with the narrow (superior) moiety, and from this point, which projects about $\frac{1}{2}$ inch, the dorsal (or posterior) border slopes very gradually downwards; on this margin, just below the shoulder, is the articular facet from the cricoid.

The lower end of the cartilage is broad and rounded and very thick.

The upper moiety or supra-arytenoid (Thompson) becomes quite thin as the extremity is approached, and the plane of this narrow plate becomes twisted near the extremity, so as to take on a position finally which makes an angle with the plane of the broad face lower down. The margin of this upper extremity is recurved, and supports the mucous membrane that constitutes the arytenoid body, and the two cartilages touch one another here.

The external surface of the posterior moiety or "processus vocalis" is irregularly convex and serves for the attachment of muscles.

The region that represents the "processus muscularis" of *Balenoptera* is here a slight, nearly circular, convex prominence, not at all well marked. The internal face of the entire cartilage is smooth.

The length of the arytenoid is $5\frac{1}{2}$ inches; its greatest breadth is $1\frac{3}{4}$ inches; while its upper moiety is only five-eighths of an inch across.

The *epiglottid cartilage* (Pl. XXVI. fig. 13, Pl. XXVII. fig. 14) has the usual trough-like character; it is, in contrast with that of *Balenoptera*, very massive, being 6 inches in length, and its greatest breadth is $1\frac{3}{4}$ inches. Seen in side view, it is club-shaped in outline; the upper, narrower region being somewhat flattened from side to side, while the broader posterior region is much compressed; at the junction of these two regions the hyo-epiglottid muscle is inserted. This lower region is rounded posteriorly, where it abuts against the thyroid plates.

The lateral surfaces are here somewhat excavated, serving for the attachment of muscles. These surfaces meet in a relatively sharp ventral edge. The upper end of the cartilage becomes quite thin, and the extreme upper margin is recurved.

The posterior or internal surface is grooved; this groove at its commencement is shallow and wide, but further down becomes deeper and narrower. Rising from the floor of the groove in the upper half is a ridge, which fades away posteriorly; thus a transverse section near the upper region is **W**-shaped, while lower down it is **V**-shaped.

The broad base of the epiglottid cartilage is capped by two small cartilages: one is patelliform, measuring $\frac{3}{4} \times \frac{1}{2}$ inch, and is thrust between the two thyroid plates so as to be visible when the ventral margins of these are parted (Pl. XXV. fig. 4); the second is smaller, oval, and nodular in form, situated dorsal of the first; it measures three-eighths of an inch long, and is closely related to the ventral edge of the right thyroid plate, connected to it by fibrous tissue. It is situated at the origin of the thyro-arytenoid muscle of the right side, and rests against a small hard prominence on the inner surface of the ventral edge of the left thyroid plate. Each of these two subepiglottid cartilages is separated from the epiglottis by the thickened layer of fibrous tissue. It is possible that they represent the "lobulæ" of the 4th and 5th visceral arch, one of which persists in *Echidna*. I saw no representative of the process (marked *c* in Howes's figures) passing inwards from the base of the epiglottis towards the base of the arytenoid, to which it is connected by fibrous tissue.

Muscles of the Larynx.

The outer surface of each thyroid plate serves for the attachment of three muscles (Pl. XXVI. fig. 6).

1. The *thyro-hyoid* muscle (*T.h.*) is attached over the whole breadth of the anterior region of the plate, partly to the thickened edge,

but also to the outer surface. Only a short piece of the muscle remained in connection with the larynx, but the anterior direction of the fibres and the position of its attachment render it probable that it is the muscle of this name.

2. Just below this is the *sterno-thyroid* muscle (*S.t.*), the fibres of which pass obliquely backwards and downwards towards the position occupied by the sternum.

3. Separated from this muscle by a sheet of fibrous tissue is a third large muscle (*x*) whose identification is uncertain. The fibres are directed antero-ventrally, *i. e.* downwards and somewhat forwards, though the inclination is but slight, and they pass nearly directly ventralwards. This mass of muscle is attached over nearly the whole of the lower half of the thyroid plate between the "bay" and the ventral margin, which, however, it does not reach. As the larynx had been cut away from the neighbouring organs, and indeed cut across near the lower end, I am unable to identify the muscle: perhaps it is an accessory sterno-thyroid.

4. The dorsal edge of the posterior cornua and of the thyroid plates also serves for the attachment of muscles, probably the stylo-pharyngeal and the basio-thyro-hyoid (*cf.* Macalister, 1867).

5. *Crico-thyroid muscle*.—This is very small in *Cogia* and invisible from without, as it is entirely concealed, partly by the posterior cornu and partly by a fan-shaped tendon that passes from its ventral edge across the "bay" to the thyroid plate. But when this tendon is removed, a small muscle is exhibited (Pl. XXV. fig. 4, Pl. XXVI. fig. 6*a*, *C.t.*). In its diminutive size it contrasts very notably with the homologous muscle in *Balenoptera*, and indicates a very feeble mobility of the thyroid cartilage upon the cricoid.

In some Odontocetes, *e. g.* *Globicephalus melas*, according to Murie (1867), this muscle is of "considerable size," while Macalister mentions that in *G. svineval* the crico-thyroid is attached "to the posterior edge of the thyroid cartilage," and makes no mention of its attachment to the cornu.

5. The *crico-arytenoid* muscle is here represented by a posterior and lateral division (the latter being absent in *Mystacocetes*).

The posterior muscle (Pl. XXV. fig. 5, *C.ar.*) is a large quadrate mass arising from the dorsal face of the cricoid and passing forwards to the arytenoid, to the "processus muscularis" to which it is attached. The lateral division (Pl. XXVII. fig. 18) arises from the side of the cricoid, ventral of the thyroid facet, and some of its fibres arise from the horn of the thyroid (as Murie states is also the case in *Globicephalus*), and indicating the close relation of this muscle to the thyro-arytenoid.

6. The transverse *arytenoid* muscle is a thin sheet having the usual relations, and forming the dorsal wall of the "aryteno-epiglottidean tube."

7. The *aryteno-epiglottid* muscle (Pl. XXVII. fig. 18, *A.ep.*) is comparatively small, and connects the lower regions only of the two cartilages.

8. Above this is a much stouter muscle, the *thyro-epiglottid* (*T.ep.*), which arises from the inner surface of the thyroid near its ventral